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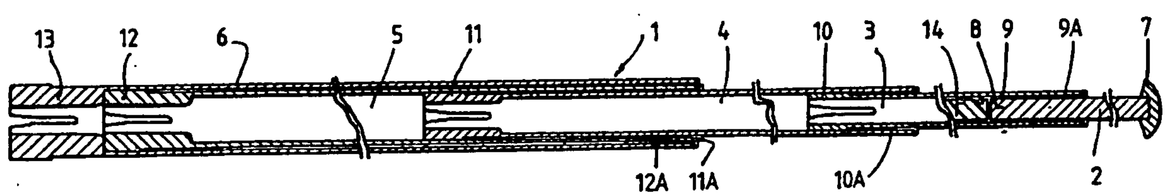
(54) Title: TELESCOPIC ANTENNA



(57) Abstract

A flexible, telescopic antenna (1) having a plurality of antenna elements (2, 3, 4, 5, 6) comprising a principal structural component based on a polymeric material, the polymeric material being associated with or impregnated with conductive material in the form of fibres and/or particles to form a matrix, each antenna element being so constructed that the fibres and/or the particles provide the required degree of surface resistivity to the antenna element.

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Title: TELESCOPIC ANTENNA

FIELD OF THE INVENTION: This invention relates to flexible, telescopic antennas.

BACKGROUND OF THE INVENTION: Antennas can take many forms depending upon their practical application and the wavelength(s) at which they are to operate. Two of the most useful general purpose types are the end-fed, multi-band antenna (or long wire type) and the vertical antenna. A common feature of antenna systems has been the use of conductive metals to form the receiving and/or transmitting element(s). For example, vehicle antennas may be made from phosphorus bronze or stainless steel.

Vehicle antennas of the rod type are commonly made from telescopic hollow metal tubes. Such antennas are usually made so that there is a degree of "slop" between the tubular components to allow for distortion of the antenna during use, so that they may still be raised and lowered. Raising and lowering may be either manual or by means of an electric motor.

Telescopic antennas for vehicles suffer from a number of disadvantages including ease of permanent bending out of shape and breaking or they may distort so that they no longer act telescopically. It is an object of the present invention to overcome or alleviate the disadvantages mentioned above.

Thus it would be desirable to provide a telescopic antenna which can be readily restored to its original shape and is resistant to permanent bending out of shape. Thus the invention seeks to provide an antenna which combines the ease of storage of a telescopic antenna with the flexibility and resistance to breakage of a whip antenna.

BRIEF SUMMARY OF THE INVENTION: Accordingly this invention provides a flexible, telescopic antenna having a plurality of antenna elements, wherein each antenna element comprises a principal structural component based on a polymeric material, the polymeric material being associated with or impregnated with conductive material in the form of fibres and particles to form

a matrix, each antenna element being so constructed that the fibres and/or the particles provide the desired degree of surface resistivity to the antenna element.

BRIEF DESCRIPTION OF THE DRAWINGS: An example of an antenna according to the invention is described below with reference to the accompanying drawings in which:

Figure 1 (a) is a longitudinal cross-section of a five-element telescopic antenna;
Figures 1(b) to 1(e) are cross sections of first (lowermost) to fourth elements respectively of the antenna; and
Figure 2 is a longitudinal cross-section of the fifth(topmost) element.

DETAILED DESCRIPTION OF THE INVENTION: Preferably either or both of the conductive particles and fibres are carbon of high electrical conductivity.

It is possible to make strong carbon (graphite) fibres by pyrolysis, at 1500° C or above, of oriented organic polymer fibres, for example, those of polyacrylonitrile, polyacrylate esters, such as rayon, or cellulose. Such fibres can also be made from petroleum pitch. These fibres, when incorporated into structural components, impart high strength to the components. The various forms of graphite fibre have differing properties, for example, they may have an amorphous structure or polycrystalline structure. A suitable size range for such fibres is from 0.2mm to 13mm in length. Some forms of graphite may have a higher electrical conductivity than others and it is with these that we are principally concerned. The resistivity (the inverse of conductivity) of certain commercially available carbon fibres may vary, for example, from 18.0 μohm/m to 2.2 μohm/m or lower.

The fibres may be single fibres with lengths as suggested above but, in another embodiment, may be in the form of longer fibres either as separate fibres or in the form of rovings.

It is preferred to use carbon particles as the conductive particles. The carbon particles may be made by any suitable means such as those mentioned above, for example, pyrolysis of carbon materials such as petroleum pitch. The particles may be ground to any desired size by any suitable means and, as in the case of the fibres, are preferably chosen to have as high electrical conductivity as possible.

The carbon particles tend to enhance the surface resistivity of the component of which they form a part and thereby improve the electrical contact between each of the elements of, for example, a telescopic antenna.

The carbon fibres chosen may be used to form rods or tubes by mixing the carbon fibres with, for example, epoxide or polyester resins. Fillers of various types may be added to the composition to improve such properties as tensile strength, scratchability etc. The rods may be used to make whip antennae and the tubes to make telescopic antennae. In the present invention, the rods may be used as part of the telescopic antenna.

The construction of the rods or tubes may be altered by the addition of reinforcing fibres such as fibreglass and Kevlar. For example, depending upon the process of fabrication used, the fibreglass may be added in the form of short fibres to the carbon fibre matrix or it may be wrapped around or within a carbon fibre tube together with the application of a suitable resin. Furthermore, parts of the telescopic tube antenna according to the invention may be replaced by metal components, of suitable conductivity, for example, to connect parts of the antenna or to act as a loading coil, as in a whip antenna comprising carbon fibres and particles. The outside of the antenna may also be chromed or coloured.

It should be noted that the additional reinforcing material may itself be conductive, for example, metal fibres may be used such as stainless steel fibres. An example of a suitable metal fibre is BEKI-SHIELD stainless steel fibre. Thus BEKI-SHIELD fibres of approximately 8 microns diameter may be used in rovings containing about 1,000 fibres.

It has been found that current flow may be concentrated at or near the surface of a conductor. The conductive particles and/or fibres are desirably in such concentrations in the matrix that they either touch or are adjacent to each other so that current flow may occur either directly or by electrons "tunnelling" through the polymeric material.

The polymeric material which forms the resin is any suitable resin, for example, polyesters or vinylesters such as those used to form polyester tubes and rods.

A suitable polymeric material for use as a matrix is known as LURAN S made by BASF (an acrylonitrile/styrene/acrylate polymer also known as ASA) blended with a thermoplastic polyester such as poly(ethylene) or poly(butylene) terephthalate.

It may also be possible to use a polymer which is itself conductive as the polymeric matrix.

A telescopic tube antenna according to the invention may be made to close tolerances, avoiding problems caused by "slop" and reducing ingress of dirt and water. Such dirt and water ingress can cause damage to conventional antennas.

The electric motor of a self-extending antenna may be replaced by a pressure/vacuum connection to the engine so that the degree of extension of the antenna can be controlled without need for an electric motor.

Generally speaking the antennas according to the invention are lighter, and more flexible than conventional antennas and do not corrode. Thus antennas according to the invention may be increased in length as compared with conventional metal antennas increasing their operational flexibility. As well as being applicable to use in vehicles, they may also be used for portable radios and televisions.

The antenna elements are generally tubular except that the upper (inner) element may alternatively be a rod. The cross-section of the tube or rod is preferably substantially round, but may be of any other suitable shape. Additional reinforcing materials may be used ranging from boron fibres to Kevlar and this reinforcing material may be oriented with respect to the polymeric matrix. The reinforcing material may also be applied to the outside of the polymeric matrix, for example, in the form of tape which is bonded to the polymeric matrix.

It may be desired to provide enhanced surface resistivity by the application to the surface(s) of a conductive, metallised coating or film.

A suitable way to introduce the conductive material either into the polymeric matrix itself or onto its surface is to use the technique of pultrusion or pull-winding.

Although the pultrusion technique has advantages when fabricating tubular elements, in that it provides good hoop strength and a smooth internal and external finish, other fabrication techniques can be used. For example, the tubular elements may be made by the use of injection moulding and/or extrusion.

In this specification the word "flexible" connotes the ability of the antenna to return to or spring back into its original shape particularly when in its extended configuration.

In one example, a mixture of ULTRABLEND (in this case ASA plus poly(butylene terephthalate)) plus 20% by weight of carbon fibres and 4% by weight of carbon particles was prepared using extrusion compounding.

The following test results were obtained:

Flexural strength:	18.5M Pa
Flexural modulus:	10,141 M Pa
Tensile strength:	127.9M Pa
Elongation:	3.3 %
Notched strength:	58.5 J/m
Reverse notched strength:	319.5 J/m
Heat deflection temperature:	219.7° C

A metal bush or bushes may be inserted into one or each tubular element of an antenna according to the invention to improve hoop strength. Furthermore, a metal bush located at an end of such an element may help to capture a neighbouring element.

Turning now to the accompanying drawings, references to "carbon fibres", "carbon fibre tubular elements" etc refer to conductive material comprising such fibres and particles as described previously. Integer 1 indicates generally a telescopic antenna according to the invention. Integer 2 indicates an end rod of solid carbon fibre; integer 3 indicates a narrow bore carbon fibre tubular element; and integers 4, 5 and 6 carbon fibre tubular elements of successively wider diameters.

Integer 7 indicates an end knob on a first end of end rod 2, preferably formed from carbon fibre. Integer 8 is a second end portion of rod 2 and integer 9 an outwardly directed metal bush around second end 8, which works in combination with inwardly directed bush 9A near a first end of tubular element 3, thus preventing rod 2 from withdrawal from tubular element 3. In turn, an outwardly diverted, spring-loaded flange means 10, near a second end of tubular element 3, works in combination with an inwardly directed bush 10A near a first end of tubular element 4. Similarly, flange means 11, bush 11A, flange means 12 and bush 12A function in an analogous way in relation to the respective remaining tubular elements, providing capturing of the respective elements 4 and 5 to allow telescoping functioning of the antenna. Finally, wider bore spring-loaded flange means 13 provides electrical and/or mechanical connection of the antenna to the body

of the vehicle. Integer 14 indicates one end of a geared nylon, push/pull drive, which is the mechanism chosen in this case to extend or retract the telescopic antenna according to the invention.

A series of contacts (not shown) may also be associated with each spring-loaded flange means, providing electrical contact between the various elements of the antenna, each contact connecting the inside of neighbouring elements.

The claims defining the invention are as follows:

1. A flexible, telescopic antenna having a plurality of antenna elements, wherein each antenna element comprises a principal structural component based on a polymeric material, the polymeric material being associated with or impregnated with conductive material in the form of fibres and particles to form a matrix, each antenna element being so constructed that the fibres and/or the particles provide the desired degree of surface resistivity to the antenna element.

2. An antenna according to claim 1, wherein either or both of the conductive particles and fibres are carbon of high electrical conductivity.

3. An antenna according to claim 1 or claim 2, wherein fillers are added to the matrix to enhance desired physical properties.

4. An antenna according to any one of claims 1 to 3, wherein reinforcing fibres are added to the matrix.

5. An antenna according to any one of claims 1 to 4, wherein a conductive, metallised coating or film is applied to the surface(s) of each antenna element to provide enhanced surface resistivity.

6. An antenna according to any one of claims 1 to 5, wherein the conductive fibres and/or particles are in such concentration in the matrix that they either touch or are adjacent to each other so that current flow may occur directly or by electrons tunnelling through the polymeric material.

7. An antenna according to any on of claims 1 to 6, wherein the polymeric material is an acrylonitrile/styrene/acrylate polymer blended with a thermoplastic polyester.

8. An antenna according to claim 7, wherein about 20% by weight of carbon fibres and about 4% by weight of carbon particles are added.

9. An antenna according to any one of claims 1 to 8, wherein each antenna element is constructed using a bush or flange element located at opposite ends of the respective antenna element, the bush or flange element being directed in such a way that adjacent antenna elements are captured with respect to each other but may move telescopically with respect to each other.

10. An antenna according to claim 9, wherein the flange element in each antenna element is constructed so as to form an integral, spring-loaded means.

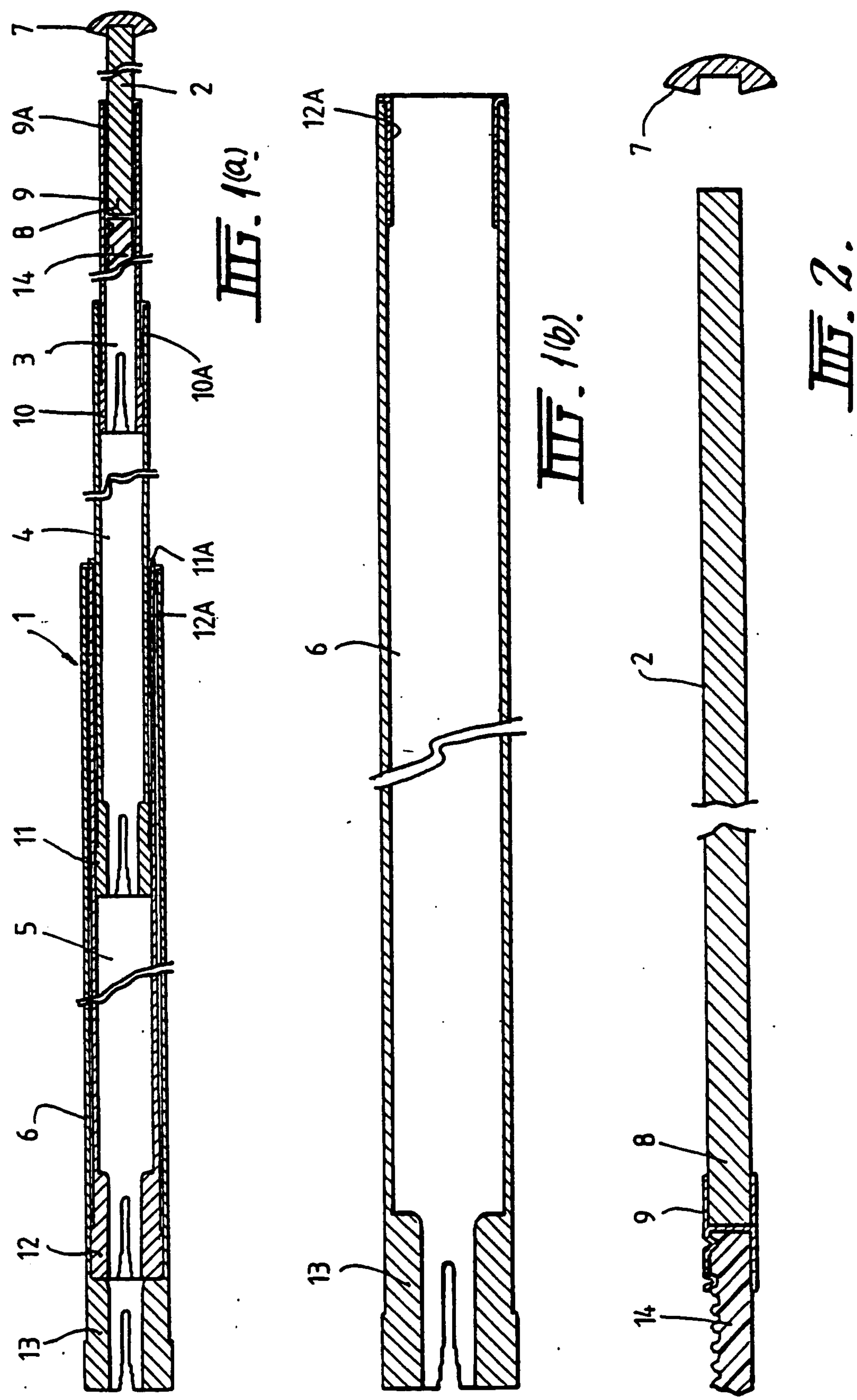

FIG. 1(a)

FIG. 1(b).

FIG. 2.

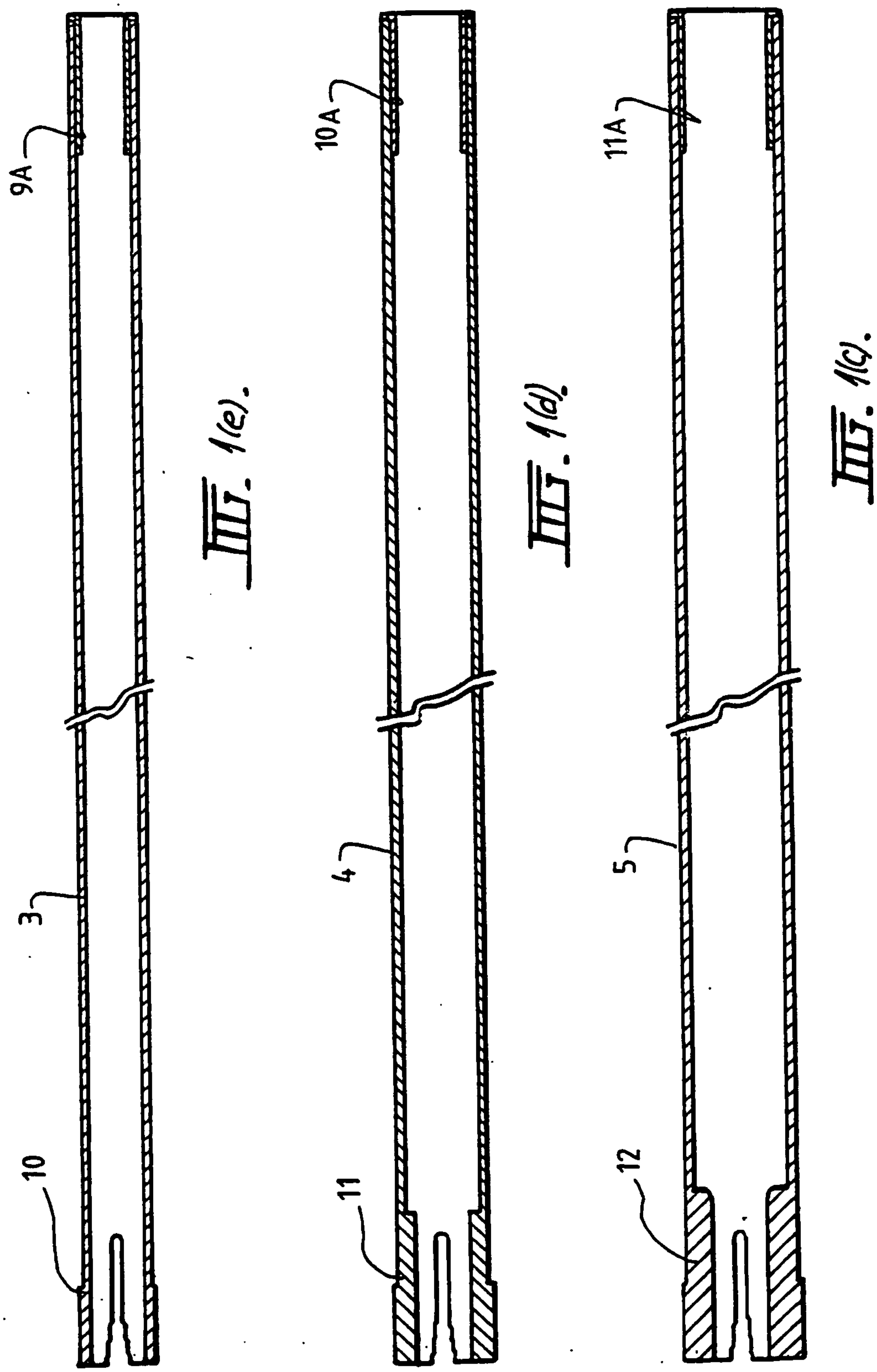

FIG. 1(e). FIG. 1(d). FIG. 1(c).

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.^{5} H01B1/20, H01Q1/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC H01B 1/20, 1/24; H01Q 1/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU:IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
	FR,A,2660116 (F.A.C.O.N. et al) 27 September 1991 (27.09.91)	
X	page 1, line 12; page 2, lines 3-5, 27, 28; page 3, line 10; Abstract	1-4
Y	pages 1-3	7
	Derwent Abstract Accession No. 84-304457/49, class W02,JP,A,59-190839 (DAINIPPON INK CHEM KK) 29 October 1984 (29.10.84)	
X	Abstract	1-2
	FR,A,2537984 (DENKI KAGAKU KOGYO KABUSHIKI KAISHA) 22 June 1984 (22.06.84)	
Y	page 8	7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
1 September 1993 (01.09.93)	16 SEP 1993 (16.09.93)
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. 06 2853929	Authorized officer R. CHIA Telephone No. (06) 2832185

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
A	WO,A,91/03847 (HUGHES AIRCRAFT COMPANY) 21 March 1991 (21.03.91) whole document	
A	GB,A,2228613 (KITAGAWA INDUSTRIES CO. LTD.) 29 August 1990 (29.08.90) whole document	

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
FR	2537984	DE	3339700	JP	59109562		
WO	9103847	CA	2036373	EP	441954		
GB	2228613	DE	3940293	JP	2165512	US	5008488

END OF ANNEX